## APPENDIX P. GOVERNMENT REGULATORY IMPACT MODEL (GRIM)

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# APPENDIX P: GOVERNMENT REGULATORY IMPACT MODEL (GRIM)

## P.1.1 INTRODUCTION AND PURPOSE

The purpose of the Government Regulatory Impact Model (GRIM) is to help identify the effects of various efficiency regulations and other regulations on manufacturers. The basic mode of analysis is to determine the change in value of the manufacturer(s) following a regulation or a series of regulations. The model structure also allows an analysis of multiple products with regulations taking effect over a period of time, and of multiple regulations on the same product.

Industry value is defined, for the purposes of this analysis as the present value of cash flows for the manufacturer(s) in question. Cash flow is calculated by the user specifying shipment volumes and manufacturer prices (i.e., prices from manufacturers to the first customer, such as a wholesaler) and then selecting user-defined regulatory levels. The model calculates the actual cash flows by year and then determines the present value of those cash flows both without regulations (the pre-regulation base case) and with regulations (the post-regulation standards case).

Output comes from the model in terms of summary statistics, graphs of major variables, and, when appropriate, access to the complete cash flow calculation.

## P.1.2 MODEL DESCRIPTION

The basic structure of the GRIM is a standard annual cash flow analysis that uses price and volume information as an input, builds on fundamental base cost information, and accepts a set of regulatory conditions as changes in costs and investments. The cash flow analysis is separated into two major blocks: income and cash flow. The income calculation determines the profit after taxes but before financial charges. The cash flow calculation converts profit after taxes into an annual cash flow by including investment and non-cash items. Below are definitions of listed items on the printout of the output sheet (see Section P1.3).

In addition to the basic structure defined below, several assumptions were added dealing with the synergies that occur between depreciation - time, ordinary R&D - product conversion, and ordinary capital expenditures - capital conversion. These synergies occur as a result of cash flow scenarios incorporating a delay in implementation and a two-tier standard. The supplemental assumptions and scenarios are explained in section P.1.4.

***(1) Income Statement:*** Overall calculation of ***Net Income Before Financing*** (17) using revenue and cost items subject to income tax effects as described in (2) through (17).

***(2) Price/Unit:*** Actual manufacturer unit price charged to the first level of distribution (distributor, retailer, etc.)
Price of Baseline Unit = $285.90[1]
Price of higher efficiency unit = Price of Baseline Unit + (Incremental Mfg. Cost) * (Mfg. Markup)

It can also be entered as an input by the user

***(3) Unit Sales:*** Annual shipments for the industry is obtained from the National Energy Savings (NES) Spreadsheet.

It can also be entered as an input by the user

***(4) Revenues:*** Annual revenues; computed by multiplying ***Price/Unit*** (2) by ***Unit Sales*** (3).

***(5) Base Costs:*** Costs per unit prior to regulations.

***(6) New Costs:*** Costs per unit following regulations.

***(7) Labor:*** Factory direct labor and fringe benefit costs;
Baseline Labor Cost = $29.3[1]
New Labor Cost = Baseline Labor Cost + Incremental Labor Cost

***(8) Material:*** Purchased materials and components;
Baseline Material Cost = $148.7[1]
New Material Cost = Baseline Material Cost + Incremental Material Cost

***(9) Overhead:*** Factory overhead excluding depreciation. Overhead is treated as both fixed and variable, with the percentage of overhead (excluding depreciation) that is variable set under the Major Assumptions.
Baseline Overhead Cost = $33.5
New Overhead Cost = Baseline Overhead Cost + Incremental Overhead Cost

***(10) Depreciation:*** Annual depreciation on pre-regulation assets; computed as a percentage of ***Revenues*** (4). Annual depreciation on post-regulation assets is computed by dividing ***Conversion Capital Expenditures*** (25) by a useful life from Major Assumptions. For post-regulation years, ***Depreciation*** is the sum of depreciation on pre- and post-regulation assets.
Pre-regulation:
Depreciation = % of annual revenues
Post-regulation:
Depreciation = Depreciation_Pre-regulation +
(Conversion Capital Exp./Useful_ life)

***(11) Cost of Sales:*** Total cost of sales, computed by adding ***Labor*** (7), ***Material*** (8), ***Overhead*** (9) and ***Depreciation*** (10).

***(12) SG&A:*** Selling, general and administrative costs are computed as a percentage of ***Revenues*** (4).

***(13) R&D:*** Research and development costs unrelated to regulations; computed as a percentage of ***Revenues*** (4).

***(14) Product Conversion:*** Expensable costs related to meeting a regulation, often including product redesign costs and expensable factory conversion expenses. Also includes costs incurred for new product literature and catalogs, product obsolescence, and various related marketing expenses. GRIM allocates these costs over a number of years.

***(15) Profit Before Tax:*** Profit before taxes and any financing costs; computed by subtracting ***Cost of Sales*** (11), ***SG&A*** (12), ***R&D*** (13), and ***Product Conversion*** (14) from ***Revenues*** (4).

***(16) Taxes:*** Taxes on ***Profits Before Tax***; computed by multiplying the tax rate contained in Major Assumptions by ***Profit Before Tax*** (15).

***(17) Net Income Before Financing:*** Profits after taxes; computed by subtracting ***Taxes*** from ***Profit Before Tax*** (15).

***(18) Cash Flow Statement:*** Overall assessment including net income, other cash related items and adjustments and investments.

***(19) Net Income:*** Net income; identical to ***Net Income Before Financing*** (17).

***(20) Depreciation:*** Depreciation is a non-cash cost and is added back into ***Net Income*** (19) as part of the cash flow calculation; identical to ***Depreciation*** (10).

***(21) Change in Working Capital:*** Additional accounts receivable, inventory, and other cash investments necessary to support increased revenues; computed by multiplying a percentage from Major Assumptions by the change in ***Revenues*** (4).

***(22) Cash Flow from Operations:*** The cash flow from operating activities; computed by adding ***Net Income*** (19), ***Depreciation*** (20) and subtracting ***Change in Working Capital*** (21).

***(23) Capital Expenditures:*** Investment to maintain and replace existing production assets; computed as a percentage of ***Revenues*** (4) using a percentage contained in Major Assumptions. Post-regulation capital expenditures equal pre-regulation expenditures plus depreciation on ***Conversion Capital Expenditures*** (24).
Pre-regulation:
Capital Exp. = % of annual revenues
Post-regulation:
Capital Exp. = Capital Exp._Pre-regulation +
(Conversion Capital Exp./Useful_ life)

***(24) Conversion Capital Exp.:*** Capital costs for meeting regulations, typically including plant, equipment, tooling and the like. These have been provided by AHAM for each efficiency level.

***(25) Cash Used in Investments:*** Cash required for assets; computed by adding ***Capital Expenditures*** (23) and ***Conversion Capital Expenditures*** (24).

***(26) Net Cash Flow:*** Annual cash flow from operations and investments; computed by subtracting ***Cash Used in Investments*** (25) from ***Cash Flow from Operations*** (22).

***(27) Post-Regulation Value:*** Value of the relevant industry following adoption and implementation of the regulatory scenario; the present value of the annual ***Net Cash Flow*** (26) from the base year to the year 2030, plus a terminal value based on the final year's cash flow valued as an annuity, are computed by model and listed. The discounted rate for the present value is the "Discount Rate for NPV" contained in Major Assumptions. Pre-regulation value is computed in a similar way using base case ***Net Cash Flows***(26) and terminal value.

### P.1.3 INCOME STATEMENT

The Income Statement and Cash Flow are shown in Figure P1.1. Two items are not shown below because the full cash flow has been cropped. These include how many years the cash flow is discounted and the terminal value. The cash flow is discounted through 2030. The terminal value is the final cash flow amount divided by the interest rate. The terminal value does not consider growth.

| Clothes Washers | | | | | | | |
|---|---|---|---|---|---|---|---|
| STANDARD CASE SCENARIO | Base Year | | Announce Year | | | Phase 1 Year | |
| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
| **Income Statement** | | | | | | | |
| Price/Unit ($) | 298.82 | 299.71 | 300.61 | 301.49 | 302.38 | 450.24 | 450.24 |
| Unit Sales (millions) | 7.74 | 7.80 | 7.85 | 7.86 | 7.85 | 7.15 | 7.28 |
| Revenues ($ million) | 2,311.9 | 2,338.6 | 2,359.1 | 2,369.2 | 2,374.5 | 3,221.2 | 3,276.1 |
| *Cost of Sales* | | | | | | | |
| Labor | 232.4 | 234.8 | 236.5 | 237.2 | 237.4 | 287.9 | 292.8 |
| Material | 1,195.6 | 1,208.9 | 1,219.0 | 1,223.8 | 1,226.1 | 1,684.4 | 1,713.0 |
| Overhead - Fixed | - | - | - | - | 67.7 | 89.6 | 89.6 |
| Overhead - Variable | 185.5 | 187.3 | 188.7 | 189.2 | 122.0 | 143.0 | 145.8 |
| Depreciation | 86.8 | 88.2 | 89.4 | 90.1 | 90.7 | 211.0 | 213.1 |
| *Selling, General and Administrative* | | | | | | | |
| Standard SG&A | 416.1 | 420.9 | 424.6 | 426.5 | 427.4 | 579.8 | 589.7 |
| R&D | 41.6 | 42.1 | 42.5 | 42.6 | 42.7 | 58.0 | 59.0 |
| Product Conversion Expense | 0.2 | 0.2 | 44.7 | 62.5 | 71.5 | 3.9 | 0.3 |
| Profit Before Tax | 153.7 | 156.2 | 113.7 | 97.2 | 88.9 | 163.7 | 172.8 |
| Taxes | 65.8 | 66.8 | 48.7 | 41.6 | 38.0 | 70.0 | 74.0 |
| Net Income Before Financing | 87.9 | 89.3 | 65.0 | 55.6 | 50.8 | 93.6 | 98.9 |
| **Cash Flow Statement** | | | | | | | |
| Net Income | 87.9 | 89.3 | 65.0 | 55.6 | 50.8 | 93.6 | 98.9 |
| Depreciation | 86.8 | 88.2 | 89.4 | 90.1 | 90.7 | 211.0 | 213.1 |
| Change in Working Capital | (12.8) | (2.8) | (2.2) | (1.1) | (0.6) | (88.9) | (5.8) |
| Cash Flows from Operations | 161.9 | 174.7 | 152.2 | 144.6 | 141.0 | 215.8 | 306.2 |
| Ordinary Capital Expenditures | (94.9) | (96.3) | (97.4) | (98.2) | (98.7) | (205.3) | (208.7) |
| Conversion Capital Expenditures | (3.6) | (3.5) | (161.6) | (224.8) | (256.8) | (3.9) | (4.4) |
| Cash Used In Investment | (98.5) | (99.8) | (259.1) | (323.0) | (355.5) | (209.2) | (213.2) |
| Net Cash Flow | 63.5 | 75.0 | (106.8) | (178.4) | (214.5) | 6.6 | 93.0 |
| Terminal Value | | | | | | | |
| Present Value Factor | 1.0000 | 0.9376 | 0.8792 | 0.8244 | 0.7730 | 0.7248 | 0.6796 |
| Discounted Cash Flow | 63.5 | 70.3 | (93.9) | (147.0) | (165.8) | 4.8 | 63.2 |
| Industry Value (Net Present Value) $ 944.7 million | | | | | | | |

**Figure P1.1 Income Statement and Cash Flow Example of GRIM Model**

## P.1.4 MAJOR ASSUMPTIONS

The GRIM is linked directly to the current version of the NES shipments model. The GRIM assumptions page (Figure P.1.2) contains all the NES assumptions required to generate shipment scenarios for GRIM. The user defines and initiates a new GRIM analysis in a simple 6 step process. Step 1 consists primarily of defining the timing and level of single-tier or two-tier standards. Step 2 defines the elasticity values used to generate shipments. Step 3 defines the financial parameters for the GRIM analysis including a description of plant and property used to calculate stranded assets. Step 4 defines additional scenario parameters: the market share under investigation (100% for the whole industry, 20%, 4.4% and 2.2% for "typical" manufacturers; the default mark-up assumptions (high and low); the presence of a delay in implementation; the assumption used to calculate stranded assets (shipments or revenue based); and consolidation or no consolidation scenarios. Step 5 contains the major assumptions for the repair industry analysis. Finally step 6 initiates the analysis calculations.

Three types of analyses are possible with the GRIM:

1. **Single-tier** - A single tier standard goes into effect at the specified date. Tier 1 inputs are repeated in tier 2 input boxes. The model behaves as previous versions of GRIM and is based on the definitions described in section P1.2.

2. **Delay** - The sigle-tier standard is implemented more than three years after the announcement date. A delay is specified in step 3. This scenario gives manufacturers extra time to ramp up investments and redistribute ordinary costs. The redistribution of costs changes the way R&D and ordinary capital expenditures are accounted. These changes are described next in the Additional Assumptions Section.

3. **Two-tier** - Two standards are implemented at different dates and efficiency levels.

Besides being linked to the NES shipment model, this GRIM is linked to the Dryer and Repair GRIMs. This system of impact analysis allows for better aggregation of total economic impact on clothes washer manufacturers.

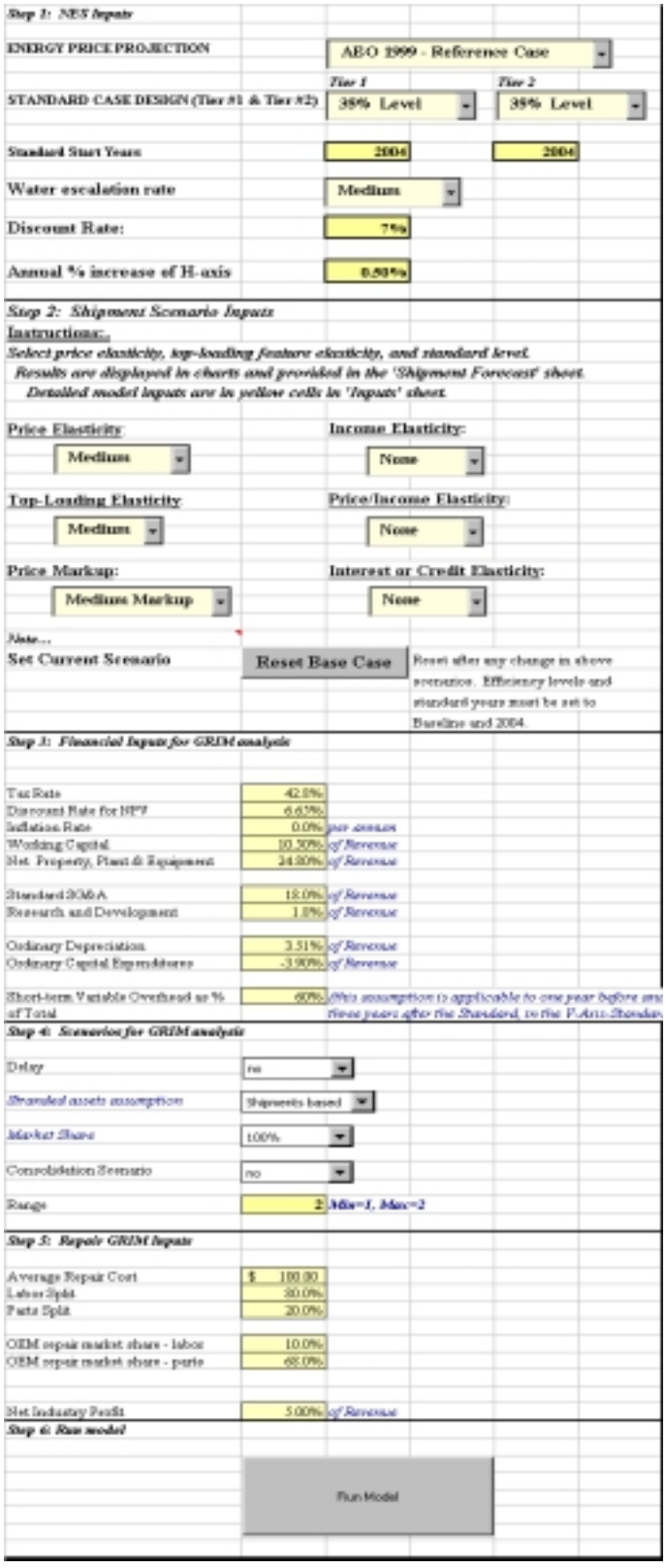


**Figure P1.2: GRIM Major Assumptions Page**

| Assumptions Page for Clothes Washers | | | |
|---|---|---|---|
| Scenario Description | Clothes Washers | | |
| | | | |
| Base Year | 1999 | | *Beginning year for analytical purposes* |
| Announcement Year | 2001 | | *Year in which the regulation announcement is made* |
| Beginning year of delay | 2004 | | |
| Standard Year (Tier 1) | 2004 | | |
| Standard Year (Tier 2) | 2004 | | *Year in which the regulation takes effect* |
| **Base Case** | **V-Axis** | **H-Axis** | |
| Base Year Unit Price | 285.90 | 478.16 | *($) per unit* |
| Mark-up over incremental cost | | 1.50 | |
| Base Year Unit Sales (from NES) | 7.22 | 0.52 | *(000,000)* |
| Materials / Unit | 148.70 | 235.43 | *($) per unit* |
| Labor / Unit | 29.30 | 40.24 | *($) per unit* |
| Overhead / Unit (excl. Depreciation) | 23.45 | 31.23 | *($) per unit* |
| | **Tier 1** | **Tier 2** | |
| | | | |
| Shipment Scenario | | | |
| Standards Case Efficiency Level | 6 | 6 | *(1 to 9)* |
| => Efficiency Improvement of | 35% | 35% | *over Baseline MEF of 0.817* |
| | | | |
| **Tier 1: Standard Case Inputs** | | | |
| **Standard Case Incremental Costs** | **V/H -Axis (over Base Case V-Axis)** | **H-Axis (over Base Case H-Axis)** | |
| Materials / Unit | 86.73 | - | *($) per unit* |
| Labor / Unit | 10.94 | - | *($) per unit* |
| Overhead / Unit (excl. Depreciation) | 7.78 | - | *($) per unit* |
| | 1.28 | | |
| Mark-up over incremental cost | 1.28 | 1.28 | *Enter markup or choose default* |
| Standard Year Unit Price | 450.24 | 450.24 | *($) per unit* |
| | | | |
| **Conversion Costs** | **V/H -Axis** | **H-Axis** | |
| Base Case Shipments in Standard Year | 7.18 | 0.71 | *(000,000)* |
| Capital Expenditure (Tooling + Investment) | 633.42 | - | |
| Useful Life | 5 | 5 | *years* |
| Per unit capital conversion cost | 17.65 | - | *($) per unit* |
| Design & Marketing Expenses (Product Conversion) | 181.82 | - | *($000,000)* |
| Per unit product conversion costs | 5.07 | - | *($) per unit* |
| Depreciation life | 5.00 | | |
| **Tier 2: Standard Case Inputs** | | | |
| **Standard Case Incremental Costs** | **V/H -Axis (over Base Case V-Axis)** | **H-Axis (over Base Case H-Axis)** | |
| Materials / Unit | 86.73 | - | *($) per unit* |
| Labor / Unit | 10.94 | - | *($) per unit* |
| Overhead / Unit (excl. Depreciation) | 7.78 | - | *($) per unit* |
| | | | |
| Mark-up over incremental cost | 1.28 | 1.28 | *Enter markup or choose default* |
| Standard Year Unit Price | 450.24 | 450.24 | *($) per unit* |
| | | | |
| **Conversion Costs** | **V/H -Axis** | **H-Axis** | |
| Base Case Shipments in Standard Year | 7.18 | 0.71 | *(000,000)* |
| Capital Expenditure (Tooling + Investment) | 633.42 | - | *($000,000)* |
| Useful Life | 5 | 5 | *years* |
| Per unit capital conversion cost | 17.65 | - | *($) per unit* |
| Design & Marketing Expenses (Product Conversion) | 181.82 | - | *($000,000)* |
| Per unit product conversion costs | 5.07 | - | *($) per unit* |
| % Capital Conversion Reinvestment | 16% | | |

**Figure P1.3: Welcome GRIM Sheet**

**Additional Assumptions for Delay and two-tier scenarios**

For the delay and two-tier scenarios several assumptions were reevaluated based on the investment dynamics of the industry. The assumptions concern ordinary R&D, ordinary capital expenditures, and depreciation.

***Delay Scenario Ordinary R&D***

It is assumed that a delay in implementation date will allow a portion of ordinary R&D expenditures to be redirected towards meeting standards-induced product conversion costs. This is modeled in GRIM as a reduction of ordinary R&D expenditures in the standard case in each of the delay years. Delay years are the years immediately following the statutory three year implementation time table. For example a standard announced in 2001 would normally be implemented in 2004. If the effective date is delayed to 2007 then 2004, 2005 and 2006 are delay years. In these years the magnitude of the reduction in ordinary R&D is the lesser of 50% of Base Case ordinary R&D and the total standard-induced marketing and design costs divided by the number of delay years.

***Delay Scenario Ordinary Capital Expenditures***

Ordinary capital expenditures are the investments associated with maintaining and replacing existing production assets. In the Base Case the GRIM models ordinary capital expenditures as a percentage of revenues. In the Standards case in the years following the standard, ordinary capital expenditures are equal to Base Case ordinary capital expenditures plus the value of capital expenditures necessary to replenish the used portion of standards-induced capital expenditures (Conversion Capital Expenditures divided by Useful life).

Given a delay in implementation date, manufacturers can better plan their ordinary capital expenditures and fully depreciate that portion of their production assets that will not be required after the standard. In order to model this effect the following steps were taken:

- The value of "stranded" production assets is estimated for each standard level. This calculation is detailed in chapter 11 and is incorporated under the sheet labeled "capital conversion" in the GRIM.
- Since stranded assets do not need to be maintained, for each delay year, the ordinary capital expenditures in the Standard Case are equal to Base Case capital expenditures reduced by a factor equal to the percentage of stranded assets. The total reduction in Capital Expenditures is capped by the amount of capital conversion costs.

***Two-tier Scenario Ordinary R&D***

In a two-tier scenario a first standard (tier one)is followed by a new standard (tier two), 3 or more years later. Introducing a delay in the implementation date for either standard reduces ordinary R&D expenditures as previously described.

***Two-tier Scenario Depreciation***

Tier one production assets' depreciation life is the difference between the tier one and tier two standard years. The maximum number of years the production assets have to depreciate is still the useful life. For example if tier one standard goes into effect in 2004 and tier two standard goes into effect in 2007 then the production assets from the tier one standard depreciate in three years instead of the useful life.

***Two-tier Scenario Ordinary Capital Expenditures***

As previously described, introducing a delay in the implementation date for tier one reduces Ordinary Capital expenditures for the delay years leading to tier one. In the years between implementation dates ordinary capital expenditures consist of two parts. As previously described for the *Delay Scenario Ordinary Capital Expenditures*, capital expenditures equal Base Case ordinary capital expenditures reduced by a factor equal to the percentage of stranded assets. The total reduction in capital expenditures is capped by the amount of capital conversion costs. A second part consists of reinvestment in tier 1 assets. This reinvestment is expressed as a fraction of normal post standard capital expenditures (Conversion Capital Exp./Useful_ life).

Capital expenditures after tier two are Capital Exp._Pre-regulation + (Conversion Capital Exp. Tier 2/Useful_ life)

***Two-tier Scenario other cash flow outputs***

The behavior of the remaining outputs presented in section P1.2. for a two-tier scenario are additive or standard specific. Costs including unit price, labor, equipment, overhead, and working capital are standard specific meaning those costs are associated with the standard being analyzed at the given point in time. The costs change when a new standard is implemented. Product and capital conversion expenditures are additive and are characterized by investing activities leading up to the implementation of a new standard.

## P.2. EXHIBITS

See exhibits for additional information.